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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/759,054	01/10/2001	Gabor Kalman	050-99-050	1934

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EXAMINER	
LAXTON, GARY L	

ART UNIT	PAPER NUMBER
2838	

DATE MAILED: 05/25/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/759,054	KALMAN ET AL.	
	Examiner	Art Unit	
	Gary L. Laxton	2838	

-- Th MAILING DATE of this communication appears on the cover sheet with the correspondenc address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 February 2004*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7,9,10,12-16,18,19 and 21* is/are rejected.

7)☒ Claim(s) *8,11,17 and 20* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

1. Applicant's arguments with respect to claims 1-7, 9-10, 12-16, 18-19 and 21 have been considered but are moot in view of the new ground(s) of rejection.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1, 13 and 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hubner (US 3,872,364) in view of Bennett et al (US 5,808,440).

Claims 1, 13 and 21, Hubner discloses a power conversion apparatus (figure 1) comprising; motor (1), a source side inverter (2) including on/off switches (2a-2f); a drive side inverter (5) including on/off switches (5a-5f); a dc current link (3a, 3b) coupled between an output of the source side inverter and an input of the drive side inverter; and a controller (8-18) for operating the source side inverter in current mode (considered to be wherein the dc link current or the output current of the rectifier is the controlled parameter – see col. 3 lines 50-55 where Hubner states, inter alia, an error signal thereby developed is provided to a current control (17) which on line (18) provides outputs to control the rectifiers 2a to 2f to cause the required amount of current to be provided in the DC link 3. (emphasis). He continues by stating, "Again,

a control arrangement such as his is conventional.") and the drive side inverter (5) operates in a commutation process.

However, Hubner does not disclose that the drive side inverter operates in a commutation mode as defined by the applicant in the specification page 4 lines 12 and 13; therein the applicant defines commutation mode to be where only three of its six switches conduct current at any time.

Bennett et al teaches that commutation is the process of driving current through the windings to produce a rotating magnetic field that the rotor attempts to catch. Commutating a spindle motor (or any DC motor), for instances is a procedure for passing current through the coils of the stator to create a shifting magnetic field that acts on the rotor of the motor to move it (col. 1 lines 63-67). The particular method for commutation involves two different current driving modes where one driving mode drives current through all three windings and the other driving mode drives current through less than all three windings of the motor (abstract). The rotor follows the magnetic field as it is constantly trying to align itself with the rotating magnetic field. The current within the coils is controlled to make the magnetic field rotate. The pattern used to pass the current through the coils to produce the rotating magnetic field is called commutation. In FIG. 5 there are six directions (e.g. a-f) in which the current may flow through windings 200, 202, 204 when driving in the bipolar drive mode or tripolar drive mode. When driving spindle motor 30 using the tripolar drive mode, two of the six current directions are simultaneously driven resulting in all three of windings 200, 202, 204 being powered (i.e. three of its six switches are conducting current at one time). Thus, for tripolar mode all three windings are simultaneously driven such that, at any time, two terminals have one polarity and the other terminal has the opposite polarity.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify Hubner with the teachings of Bennett et al in order to drive the motor of Hubner in a commutation mode that satisfies operating three of its six switches to be conducting current at any one time in order to commutate the motor to make it spin with less noise and vibration as taught by Bennett et al (abstract; col. 10 lines 34-40; col. 1 lines 64-67; col. 3 lines 1-8; col. 4 lines 60-67; col. 5 lines 1-10; col. 7 lines 15-36).

4. Claims 2, 3, 5, 10, 14, 15, and 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hubner (US 3,872,364) and Bennett et al (US 5,808,440) in view of Bernet et al (US 5,949,664).

Claim 2, Hubner and Bennett et al disclose the claimed subject matter as stated in regards to claim 1 supra, except for wherein the controller commands the source-side inverter to perform current regulation on the dc current link during a first portion of each modulating and current mode space vector modulation during a second portion of each modulating cycle.

Bernet et al teach using space vector modulation as a current regulation scheme; see also the modulation cycle: col. 13 lines 35-67; col. 14 lines 1-16; col. 14 lines 43-47 and figure 9, wherein the controller commands the source-side inverter to perform current regulation on the dc current link during a first portion of each modulating and current mode space vector modulation during a second portion of each modulating cycle.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to use a modulation cycle that performed current regulation on the dc current link during a first portion of each modulating and current mode space vector modulation during a second portion of each modulating cycle as taught by Bernet et al in order to converter a

three phase current into a regulated single phase dc link current to meet the current demands from the motor side inverter in order to provide adequate power and current to the motor under differing load demands.

Claims 3 and 14; Hubner and Bennett et al disclose the claimed subject matter in regards to claims 2 and 13, supra, except for the controller varies the duty cycle of each first portion to control average current in the dc link.

Bernet et al teach a Pulse Width Modulated system in which the duty cycle is varied in order to modulate the pulse width to provide the desired on time and off time for the switch to control the current.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to utilize a controller that varies the duty cycle of each first portion to control average current in the dc link in order to modulate the pulse width to provide the desired on time and off time for the switch to control the current in that portion.

Claim 5, during each second portion the controller modulates switches of the source side inverter to extract fundamental frequency sinusoidal currents from an ac power source (this is inherent, see also Bernet et al col. 2 lines 10-17).

Claim 10, the controller commands the drive side inverter to generate active vectors only; and wherein null vectors are imposed by the source side inverter (col. 5 lines 35-40; col. 13 line 63; col. 14 lines 43-46, line 56).

Claim 15, the first inverter is terminated in a capacitor bank (Bernet et al figure 1A); wherein the space vector modulation produces a current vector; and wherein the circuit uses phase angle of the current vector to command switches of the first inverter to connect selected

phases of the capacitor bank of the dc current link (this is normal space vector modulation and inherent in Bernet et al).

Claim 19, the circuit commands the second inverter to generate active vectors only; and wherein null vectors are imposed by the first inverter (Bernet et al col. 5 lines 35-40; col. 13 line 63; col. 14 lines 43-46, line 56).

5. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hubner (US 3,872,364), Bennett et al (US 5,808,440) and Bernet et al (US 5,949,664) in view of Ma et al (US 6,366,483).

Hubner, Bennett et al and Bernet et al disclose the claimed subject matter in regards to claim 2, supra, except for the controller operates the source side inverter as a buck chopper during each first portion to perform the current regulation.

Ma et al (483') teaches of a PWM Rectifier with power factor correction and current control and further specifically teaches the illustrated rectifier (24) can be implemented using other types of rectifiers such as a dc chopper (col. 8 line 63).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the rectifier circuit of Hubner, Bennett et al and Bernet et al to include a dc chopper with the suggestion of Ma et al (483') of using a dc chopper rectifier as an alternative rectifier implementation (col. 8 line 63).

6. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hubner (US 3,872,364), Bennett et al (US 5,808,440) and Bernet et al (US 5,949,664) in view of Rozman (US 6,084,786).

Hubner, Bennett et al and Bernet et al disclose the claimed subject matter in regards to claim 5, supra, and the source side inverter is terminated in a capacitor bank (Bernet et al Fig 1A); and the space vector modulation produces a current vector; and wherein the controller uses phase angle of the current vector to command the source side inverter switches to connect selected phases of the capacitor bank capacitors to the dc current link, supra claim 2.

However, Hubner, Bennett et al and Bernet et al do not teach maintaining a relatively ripple free current on the dc link.

Rozman teaches a AC/DC converter system with a capacitor bank and current regulator in figure 1 and specifically teaches controlling the rectifier converter so as to reduce ripple on the DC link (col. 4 lines 36-46 and col. 8 lines 54-57).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to maintain a relatively ripple free current on the dc link as specifically suggested and taught by Rozman (col. 4 lines 36-46 and col. 8 lines 54-57) in order to provide a smooth and ripple output to by used by a load.

7. Claims 7 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hubner (US 3,872,364), Bennett et al (US 5,808,440), Bernet et al (US 5,949,664) and Rozman (US 6,084,786) as applied to claim 6 supra, and further in view of Ma et al (US 6,366,483).

Hubner, Bennett et al, Bernet et al and Rozman disclose the claimed subject matter in regards to claims 6 and 15 supra, except for the controller also performs damping during each second portion of the modulating cycle by modifying the phase angle.

Ma et al (483') teaches of a PWM Rectifier with power factor correction and current control and further specifically teaches active damping by modifying the phase angle (col. 8 lines 35-41, inter alia) in order to prevent the rectifier from resonant oscillation and to suppress resonance modes (col. 4 lines 38-40).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to perform damping during each second portion of the modulating cycle by modifying the phase angle in order to prevent the rectifier from resonant oscillation and to suppress resonance modes (col. 4 lines 38-40) as taught by Ma et al (483').

8. Claims 9 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hubner (US 3,872,364), Bennett et al (US 5,808,440) and Bernet et al (US 5,949,664) in view of Kalman et al (US 5,428,283).

Hubner, Bennett et al and Bernet et al disclose the claimed subject matter in regards to claims 1 and 13, supra, except for the controller performs power factor control of the drive side inverter such that motor current is in phase with motor back emf.

Kalman et al teaches power factor control of a pulse width modulated inverter supplied permanent magnet motor for power factor changes in accordance with changes in emf and motor resistance (abstract).

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the controller of Hubner, Bennett et al and Bernet et al to perform power factor control of the drive side inverter such that motor current is in phase with motor back emf as taught by Kalman et al in order to maintain approximately unity power factor over a wide range of EMF (i.e. magnet strength) and/or temperature (i.e. ohmic resistance) changes (col. 3 lines 5-11).

9. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hubner (US 3,872,364), Bennett et al (US 5,808,440) and Bernet et al (US 5,949,664) in view of Jiang (US 5,793,626).

Hubner, Bennett et al and Bernet et al disclose the claimed subject matter in regards to claims 1 and 13, supra, except for the dc current link include a diode bridge for bi-directional flow.

Jiang figure 8 teaches using a diode bridge connected between an inverter and converter for bi-directional power flow therebetween.

Therefore, it would have been obvious to one having ordinary skill in the art at the time the invention was made to modify the circuit of Hubner, Bennett et al and Bernet et al to include a diode bridge in the dc link in order to provide for bi-directional power flow from the inverter to the converter and vice versa as suggested by Jiang.

Allowable Subject Matter

10. Claims 8, 11, 17 and 20 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

11. The following is a statement of reasons for the indication of allowable subject matter: the indication of allowable subject matter is the same as stated in the previous office action dated 11/25/03.

Conclusion

12. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. US 4,833,584 Divan teaches that in a current mode inverter the directly controlled parameter is inductor current.

13. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Gary L. Laxton whose telephone number is (571) 272-2079. The examiner can normally be reached on Monday thru Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Sherry can be reached on (571) 272-2084. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Gary L. Laxton
Patent Examiner
Art Unit 2838

GLL